Nov. 8, 1960 C. A. PARKER 2,959,658

SEQUENCE SWITCH

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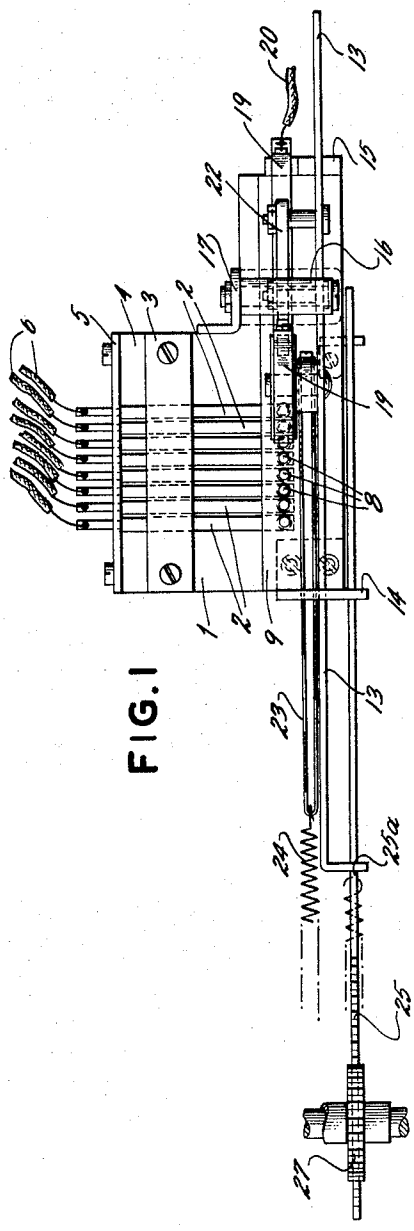

FIG. 1

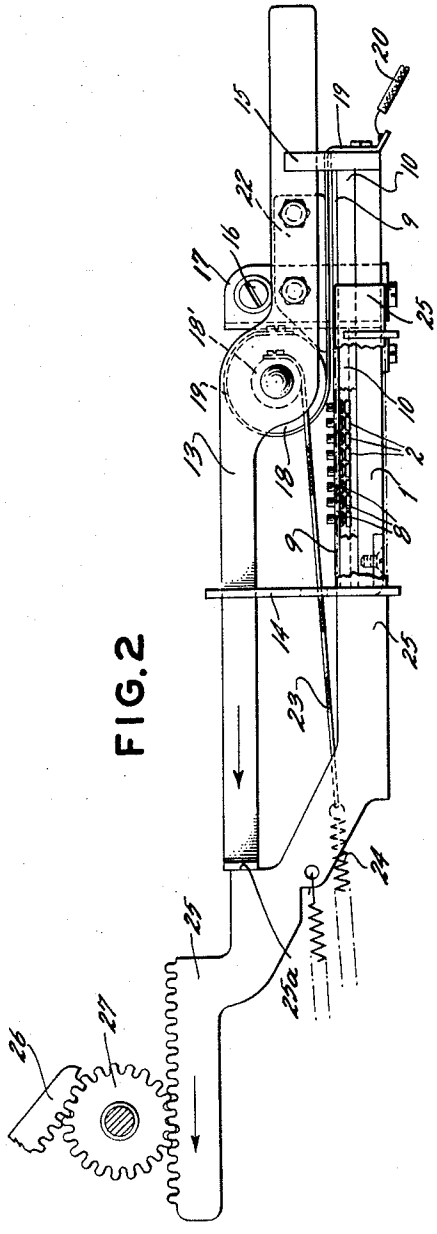

FIG. 2

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FIG. 3

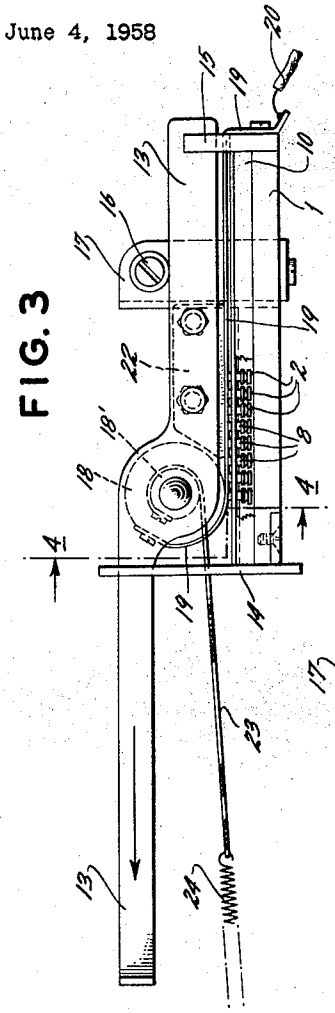


FIG. 5

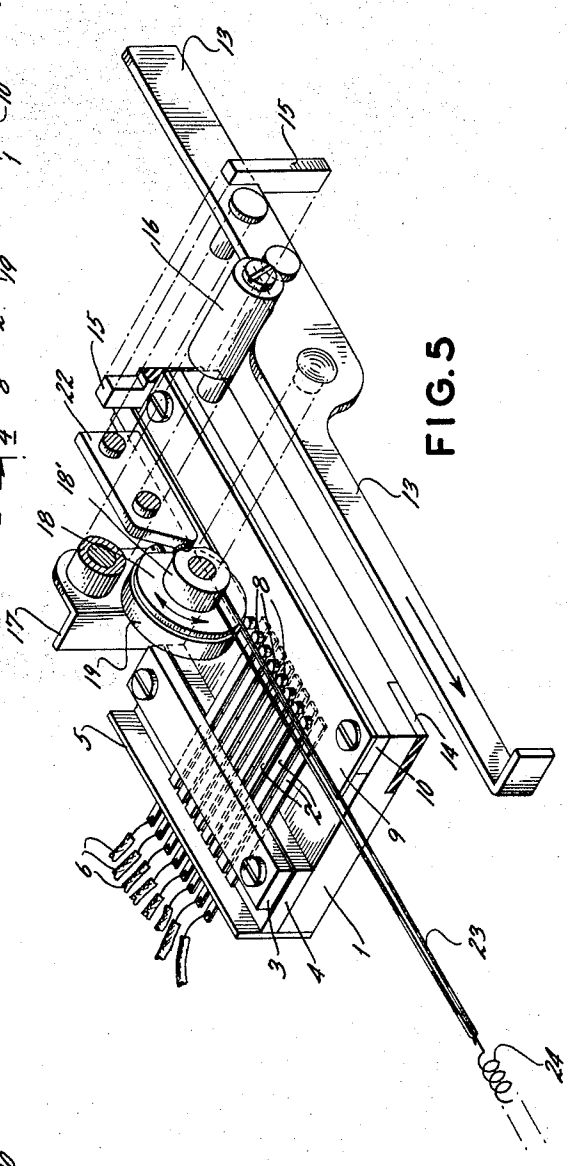
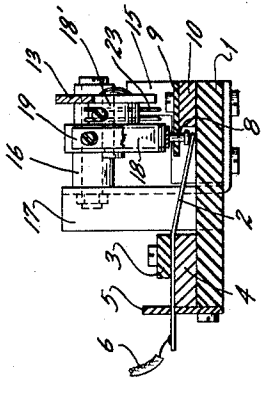


FIG. 4



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SEQUENCE SWITCH

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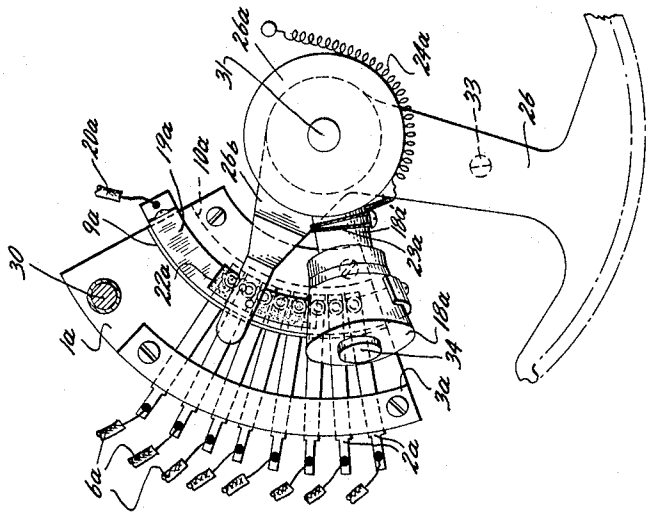

FIG. 8

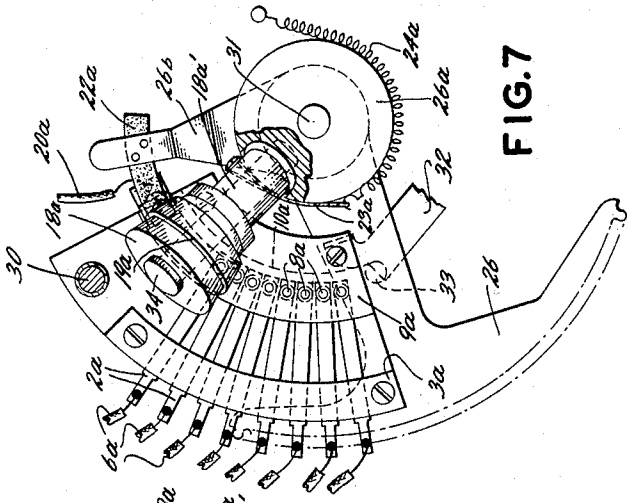

FIG. 7

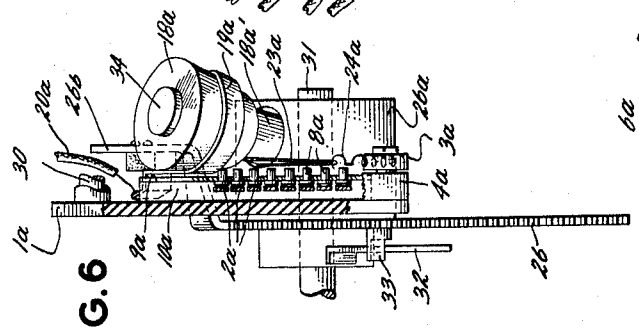

FIG. 6

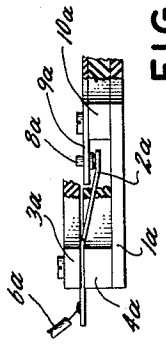

FIG. 9

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SEQUENCE SWITCH

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Filed June 4, 1958, Ser. No. 739,827

17 Claims. (Cl. 200—166)

This invention relates to electrical switches. More particularly, the invention relates to a switch including means for sequentially closing and holding closed a series of contacts.

In certain apparatus, such as exemplified by the disclosure of applicant's co-pending application Serial No. 730,094, filed on April 22, 1958, a plurality of electrical circuits respectively include a series of contacts. These contacts are included in a switch operating in accordance with the switch of the present invention. It will be understood, however, that this is only one utility of the invention and that its use is not restricted to such apparatus. To the contrary, the invention has equal utility in other apparatus wherein the operation requires the sequential closure of a series of circuit contacts and particularly where it is desirable to hold the contacts closed.

It is accordingly the primary object of the invention to provide a switch wherein a series of contacts are sequentially closed and held closed in a manner which causes minimum wear on the contact surfaces and yet which insures good electrical conduction.

Another object of the invention is to provide a switch wherein a common conductor is most efficiently adapted to sequentially close and hold closed a series of contacts.

Another and more specific object of the invention is to provide a switch wherein a common conductor is particularly adapted to sequentially close and hold closed a linear series of contacts.

Another more specific object of the invention is to provide a switch wherein a common conductor is particularly adapted to sequentially close and hold closed an arcuate series of contacts.

Other objects and advantages of the invention will be apparent from the following description with reference to the accompanying drawings in which:

Fig. 1 is a plan view of the switch.

Fig. 2 is a side elevation of the switch with the parts in normal position.

Fig. 3 is a side elevation of the switch with the parts in operated position.

Fig. 4 is a section taken of the line 4—4 of Fig. 3.

Fig. 5 is an exploded perspective view of the switch.

Fig. 6 is a front view of a modified form of the switch with parts broken away and the parts in normal position.

Fig. 7 is a side elevation of the modified form of the switch with the parts in normal position.

Fig. 8 is a side elevation of the modified form of the switch with the parts in operated position.

Fig. 9 is a fragmentary bottom end view of the modified form of the switch.

In a preferred embodiment of the invention illustrated in Figs. 1–5, the various elements of the sequence switch are mounted on a baes plate 1 of insulating material. Any strong insulating material such as fiber filled phenolic may be employed for plate 1 and for other insulating members of the switch described later. A series of resilient conductive arms 2 (Figs. 1, 4, 5) in the form of flat strips are secured between a pair of clamping plates

3 and 4, also of insulating material and mounted longitudinally adjacent the rear of base plate 1. The rear ends of arms 2 extend through a vertical spacing plate 5 of insulating material mounted at the rear of plate 1 and each is connected with a lead 6. Resilient arms 2 extend forwardly and each engages the head of a contact pin 8 which extends upwardly through a suitable opening in a spacing plate 9 of insulating material which is raised from base plate 1 by a plate 10 also of insulating material.

A slide 13 is mounted in a pair of brackets 14 and 15 of insulating material above and adjacent the front edge of plate 1. To further secure slide 13, a guide roller 16 is mounted on a bracket 17 at the rear of plate 1 and extends forwardly above and in engagement with the upper edge of the slide. A roller 18 of insulating material, preferably nylon, is mounted intermediate the ends of slide 13 with its axis parallel to arms 2 and in the vertical plane of the series of contact pins 8.

A conductive band 19 of flexible material is attached to the periphery of roller 18 and, from the point of attachment, extends counterclockwise and to the right end of plate 1 where it is secured to bracket 15. Attached at the right terminal end of band 19 is a lead 20.

Slide 13, as later described, is normally positioned toward the right (Figs. 1, 2, 5) with roller 18 and band 19 immediately to the right of the rightmost contact pin 8. To prevent buckling of the rightward extension of band 19, the lower edge of a pressure plate 22 of insulating material, which is attached to arm 13, engages the upper face of the band.

Roller 18 is provided with a hub 18'. An operating band or cable 23 is attached at one end to the periphery of hub 18*a* and from the point of attachment extends clockwise and to the left of base plate 1. A spring 24 is attached to the left end of cable 23 and therefore urges roller 18 and slide 13 toward the left. Slide 13, however, is normally held toward the right by a rack 25 having a shoulder 25*a* which engages the left end of the slide.

As fully disclosed in applicant's aforenoted co-pending application Serial No. 730,094, rack 25 is operated in unison with a segmental rack 26 (Fig. 2) of an accounting machine. Rack 26 is a replica of the differentially operable registering actuator racks of the machine but is non-registering. Upon each cycle of operation of the accounting machine, rack 26 is rocked counterclockwise a fixed distance and restored. Rack 26 engages an intermediate gear 27 which meshes with rack 25. Therefore, during each machine cycle, rack 25 will be moved toward the left and restored.

Upon leftward movement of rack 25, slide 13 and roller 18 will no longer be restrained in rightward position and spring 24 will therefore be rendered effective. Cable 23 is wound in such direction on hub 18*a* as to impart, by the leftward urge of spring 24, a clockwise torque to roller 18. Band 19 encircles roller 18 in the direction opposite to that of cable 23 on hub 18*a*, and therefore the torque will hold the roller clockwise to take up any slack between the band and the roller and to insure that the band will be held taut from its point of attachment at the right end of plate 1. With band 19 taut, the force of spring 24 will be transmitted to the periphery of roller 18. This force will be equal and opposite to the force transmitted to the periphery of hub 18*a*. However, because of the greater diameter of roller 18 with respect to hub 18*a*, the roller will be rotated counterclockwise, thereby moving toward the left and unrolling band 19 while at the same time cable 23 will be further wound upon hub 18*a* as shown in Fig. 3.

As roller 18 moves toward the left, band 19 will successively engage pins 8 which will yield by the resiliency of arms 2. Thus a circuit connection will be made between each lead 6 and common lead 20. It will be

noted that as each pin 8 is engaged, there will be a slight wiping action with contact strip 19 thereby insuring a good conducting surface without causing undue wear as occurs in conventional sliding contacts. Furthermore, because of the rolling action, each engaged pin will be decelerated as it reaches its full depressed position thus eliminating the possibility of vibration and poor conduction. Also, it will be observed that the clockwise torque imparted to roller 18, as the force of spring 24 diminishes, will be constantly proportional to the force which rotates roller 18 counterclockwise. This insures maximum efficiency of spring 24 to maintain the tautness of band 19 and to rotate roller 18 to engage the band with pins 8. Furthermore, pressure plate 22 engages the band above the engaged pins to the right of roller 18 (Fig. 3) preventing buckling of the band to further insure positive contact. As rack 25 is restored toward the right, slide 13 and roller 18 will be likewise restored to disengage pins 8 from band 19 in reverse sequence.

In the modified form of the invention illustrated in Figs. 6–9, the switch is adapted to be operated by direct connection with segmental rack 26 which, as before noted, is rocked a fixed distance during each cycle of the differentially operable actuator racks of an accounting machine. The operating principles of the modified form are substantially the same as those of the embodiment of Figs. 1–5 and corresponding parts will be identified, where practical, by like numerals with the suffix (*a*).

The switch includes a segmental base plate 1*a* of insulating material which may be mounted on the machine frame (not shown) in any suitable manner such as by one or more studs 30. A series of radially extending resilient conductive arms 2*a* in the form of flat strips are secured at the outer edge of plate 1*a* between a pair of arcuate insulating clamping plates 3*a* and 4*a* (Fig. 9). The outer ends of arms 2*a* are each connected with a lead 6*a*. The inner ends of arms 2*a* each engage the head of a contact pin 8*a* which extends through one of an arcuate series of openings in a spacing plate 9*a* of insulating material spaced from base plate 1*a* by a plate 10*a* also of insulating material.

Pins 8*a* are located on the arc of a circle having its center at the axis of a shaft 31 on which segmental rack 26 is pivotally mounted. As described in the aforenoted application Serial No. 730,094, rack 26 is normally restrained in clockwise position (Fig. 7) by a dog 32 which engages a stud 33 on said rack.

Integral with rack 26 is a hub 26*a*, and mounted on a spindle 34 on hub 26*a* is a roller 18*a* of insulating material. The sides of roller 18*a* are radial with respect to the axis of shaft 31 and is therefore so tapered that it is adapted for rolling movement along the arc of contact pins 8*a*. Spindle 34, which is fixed in hub 26*a*, is inclined outwardly from base plate 1*a*. The location of spindle 34 in hub 26*a* and its inclination is such that the peripheral surface of roller 18*a* is parallel to and immediately adjacent the face of plate 9*a* through which pins 8*a* extend.

An arcuate conductive band 19*a* of flexible material is attached to roller 18*a* and, from the point of attachment, extends clockwise around said roller and clockwise (Figs. 7, 8) along plate 9*a* to the edge of base plate 1*a* where it is secured and attached to a lead 20*a*.

When rack 26 is in normal clockwise position (Fig. 7), roller 18*a* and band 19*a* will be located immediately clockwise of the clockwisemost pin 8*a*. To prevent buckling of the portion of band 19*a* which extends clockwise from roller 18*a*, an insulating pressure plate 22*a* mounted on an arm 26*b* of rack 26 is adapted to engage the face of that portion of the band.

Roller 18*a* is provided with a hub 18*a*′. Hub 18*a*′ extends between roller 18*a* and hub 26*a* into which it is recessed. An operating cable 23*a* is attached at one end to the periphery of hub 18*a*′ and from the point of attachment extends counterclockwise and then counterclockwise a short distance around hub 26*a*. A spring 24*a* is attached to the end of cable 23*a* and continues counterclockwise around hub 26*a* to a straightened position where it is secured to the machine frame. Therefore, because of the attachment of spring 24*a* with hub 18*a*′, hub 26*a* and rack 26 will be biased counterclockwise (Figs. 7, 8) on shaft 31.

Upon each machine cycle, as disclosed in application No. 730,094, a frame (not shown) upon which dog 32 is mounted, is rocked counterclockwise and restored. Rack 26 and hub 26*a* therefore will be released for like movement under the urge of spring 24*a*. Cable 23*a* is wound in such direction on hub 18*a*′ as to impart, by the counterclockwise urge of spring 24*a*, a counterclockwise torque to roller 18*a*. Band 19*a* encircles roller 18*a* in the direction opposite to that of cable 23*a* on hub 18*a*′, and therefore the torque will hold the roller counterclockwise to take up any slack between the band and the roller and to insure that the band will be held taut from its point of attachment on base plate 1*a*.

With band 19*a* taut, the force of spring 24*a* will be transmitted to the periphery of roller 18*a*. This force will be equal and opposite to the force transmitted to the periphery of hub 18*a*′. However, because of the greater diameter of roller 18*a* with respect to hub 18*a*′, the roller will be rotated clockwise on spindle 34 thereby rolling in counterclockwise direction (Figs. 7, 8) with hub 26*a* and rack 26 under the urge of spring 24*a*. Band 19*a* will therefore be unrolled while at the same time cable 23*a* will be further wound on hub 18*a*′ as shown in Fig. 8.

As roller 18*a* moves counterclockwise with hub 26*a* and rack 26, band 19*a* will successively engage pins 8*a* which will yield by the resiliency of arms 2*a*. Thus a circuit connection will be made between each lead 6*a* and common lead 20*a*. During this operation, pressure plate 22*a* will engage band 19*a* above engaged pins 8*a* to prevent buckling of the band thereby insuring positive contact. As rack 26 is restored, roller 18*a* will be likewise restored and pins 8*a* will be disengaged from band 19*a* in reverse sequence.

It will be obvious that both rollers 18 and 18*a*, of the two embodiments of the invention, may be controlled by suitable reciprocally operable means other than that herein disclosed. Such means may be either manually or automatically operable. It will be understood therefore that the aforedescribed controls of the switch by rack 26 are only illustrative of practical embodiments of the invention which therefore is to be restricted only as necessitated by the scope of the appended claims.

I claim:

1. In an electrical switch: a series of contacts; a roller; a flexible contact band attached at one end to the periphery of said roller and normally at least partially encircling said roller; means for restraining the other end of said band; and means for unrolling said band to successively engage and maintain engagement of said band with said contacts.

2. In an electrical switch: a linear row of contacts; a roller; a flexible contact band attached at one end to the periphery of said roller and normally at least partially encircling said roller; means for restraining the other end of said band; and means for unrolling said band to successively engage and maintain engagement of said band with said contacts.

3. In an electrical switch: a series of contacts; a roller; means for locating said roller at one end of said series of contacts; a flexible contact band attached at one end to the periphery of said roller, passing around said roller and fixed at its other end at said one end of said series of contacts; and means for moving said roller along said contacts thereby unrolling said band to successively engage said band with said contacts.

4. In an electrical switch: a linear row of contacts; a

roller; means for locating said roller linearly from one end of said row; a flexible contact band attached at one end to the periphery of said roller, passing around said roller and fixed at its other end linearly from said one end of said row; and means for moving said roller along said row thereby unrolling said band to successively engage said band with said contacts.

5. In an electrical switch: a linear row of contacts; a roller; a flexible contact band attached at one end to the periphery of said roller, passing around said roller and fixed at its other end linearly from one end of said row; resilient means operable to move said roller along said row from said fixed end of said band thereby unrolling said band to successively engage said contacts; and reciprocably operable control means for restoring said roller against the urge of said resilient means and for releasing said roller to permit operation of said resilient means.

6. In an electrical switch: a linear row of contacts; a roller; a flexible contact band attached at one end to the periphery of said roller, passing around said roller and fixed at its other end linearly from one end of said row; and means for transmitting a torque to said roller in the direction to hold said band tightly thereon and to rotate said roller in the opposite direction thereby engaging said band successively with said contacts.

7. The invention according to claim 6 wherein said means for transmitting said torque and for rotating said roller urges said roller linearly along said contacts away from said fixed end of said band.

8. The invention according to claim 6 wherein said means for transmitting said torque, for rotating and urging said roller includes resiliently operable means.

9. In an electrical switch: a linear row of contacts; a roller including a hub; a flexible band attached at one end to the periphery of said roller, passing around said roller in a given direction and fixed at its other end linearly from one end of said row; a cable attached at one end to the periphery of said hub, passing around said hub in the opposite direction and extending linearly toward the other end of said row; and means for pulling said cable thereby moving said roller along said row and unrolling said band to successively engage said contacts.

10. The invention according to claim 9; wherein said means for pulling said cable is resilient.

11. The invention according to claim 10; including means for restraining said roller in position adjacent said one end of said row and reciprocably operable to permit operation of said resilient means.

12. The invention according to claim 9; wherein said contacts are resiliently yieldable.

13. In an electrical switch: an arcuate series of contacts; a roller having its sides tapered to adapt it for rolling movement along the arc of said series of contacts; means for locating said roller at one end of said series of contacts; an arcuate and flexible contact band attached at one end to the periphery of said roller, passing around said roller and fixed at its other end at said one end of said series of contacts; and means for moving said roller along said contacts thereby unrolling said band to successively engage said band with said contacts.

14. In an electrical switch: an arcuate series of contacts; a roller having its sides tapered to adapt it for rolling movement along the arc of said contacts; a support for said roller pivotally mounted at the center of the arc of said contacts for moving said roller along said arc; resilient means for rocking said support; means for restraining said support against the urge of said resilient means to locate said roller at one end of said series of contacts; an arcuate and flexible contact band attached at one end to the periphery of said roller, passing around said roller and fixed at its other end at said one end of said series of contacts; and means for releasing said restraining means to permit said support to move said roller along said contacts thereby unrolling said band to successively engage said band with said contacts and for restoring said restraining means.

15. The invention according to claim 14; said resilient means for rocking said support being attached to said roller.

16. In an electrical switch: an arcuate series of contacts; a roller having its sides tapered to adapt it for rolling movement along the arc of said contacts and including a hub; a support for said roller pivotally mounted at the center of the arc of said contacts for moving said roller along said arc; an arcuate and flexible contact band attached at one end to the periphery of said roller, passing around said roller in a given direction and fixed at its other end at one end of said series of contacts; a cable attached at one end to the periphery of said hub, passing around said hub in the opposite direction and extending toward the other end of said series of contacts; and resilient means for pulling said cable thereby rocking said support and moving said roller along said contacts to unroll said band and successively engage said contacts therewith.

17. The invention according to claim 16; including means for restraining said support against the urge of said resilient means to locate said roller adjacent said one end of said series of contacts and reciprocably operable to permit operation of said resilient means.

References Cited in the file of this patent

UNITED STATES PATENTS

1,651,275	Hirsch	Nov. 29, 1927
1,677,288	Newman	July 17, 1928
1,834,896	Bruno	Dec. 1, 1931
2,134,323	Beach	Oct. 25, 1938
2,341,931	Lloyd	Feb. 14, 1945
2,384,652	Smith	Sept. 11, 1945
2,407,509	Oetzel	Sept. 10, 1946
2,467,758	Lindenbald	Apr. 19, 1949
2,474,988	Sargrove	July 5, 1949